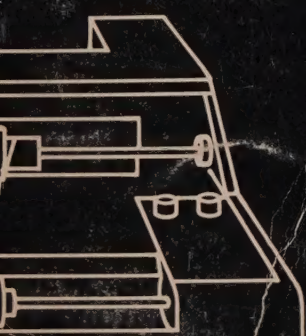
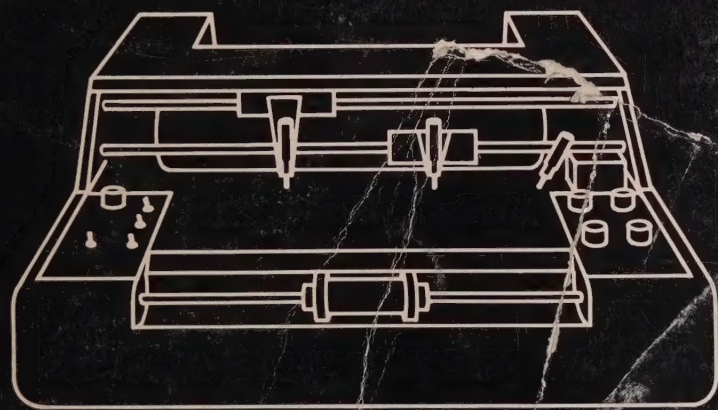
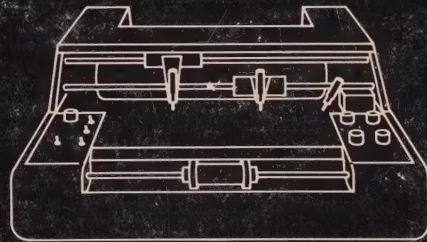
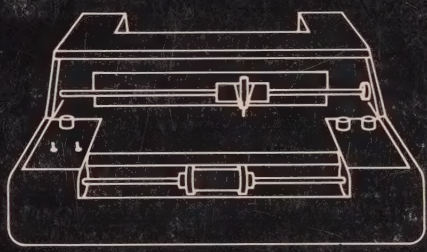
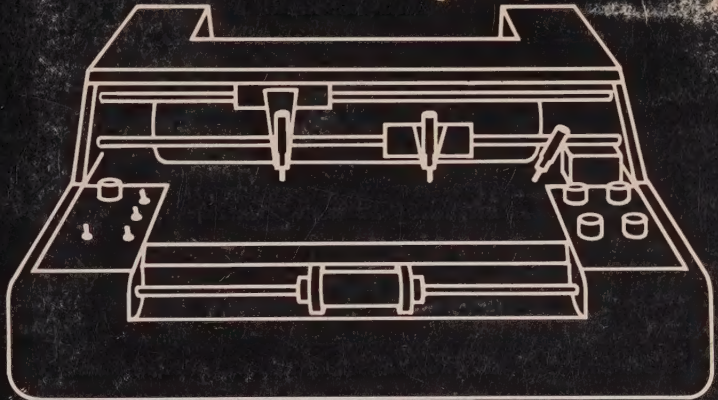
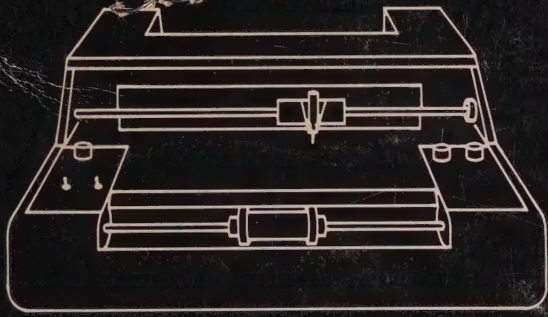


OMEGALINE

Strip Chart Recorder

INSTRUCTION

MANUAL

 **OMEGA**
ENGINEERING, INC.
An OMEGA Group Company

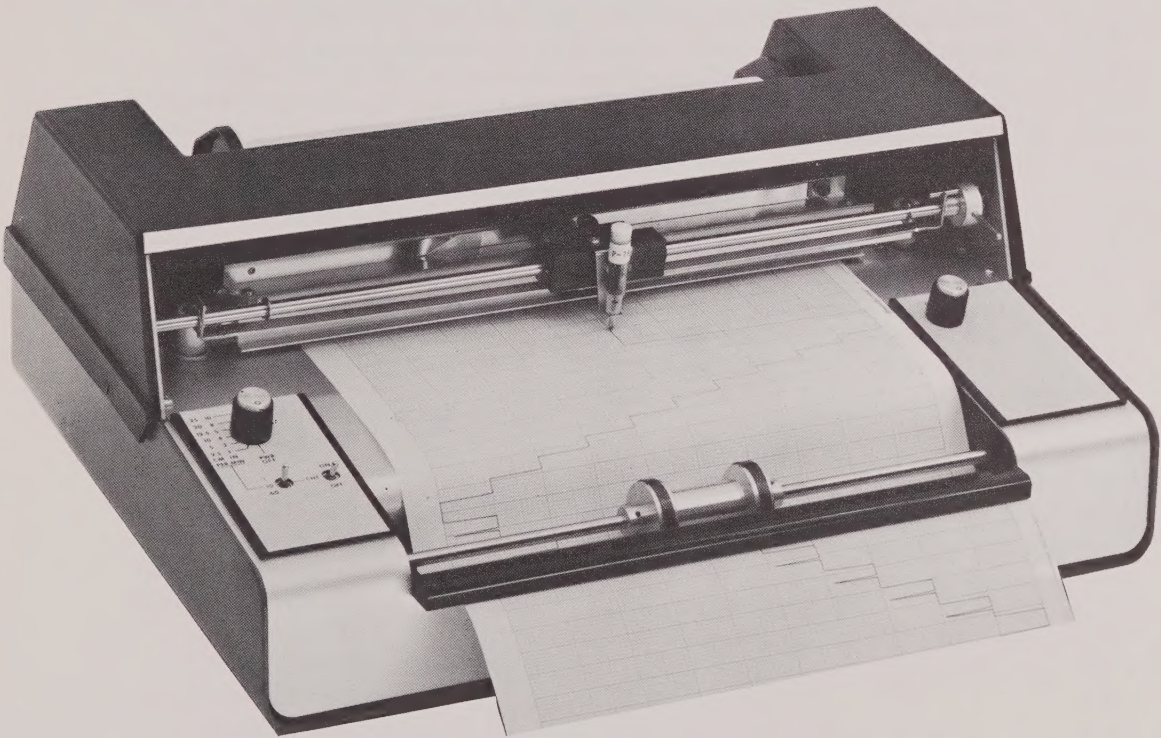
One Omega Drive, Box 4047
Stamford, Connecticut 06907
(203) 359-1660 Telex 996404 Cable: OMEGA



OMEGALINE[®]

Strip Chart Recorder

INSTRUCTION MANUAL



**SERIES
5000**

CERTIFICATION

OMEGA ENGINEERING, INC., certifies that this instrument was thoroughly inspected and tested at the factory prior to shipment and found to meet all requirements defined by the contract under which it is furnished.

WARRANTY AND ASSISTANCE

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of 1 year. If the unit should malfunction, it must be returned to the factory for evaluation. Our Customer Service Department will issue an Authorized Return Number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with, shows evidence of being damaged as a result of excessive current, heat moisture, vibration or misuse. OMEGA assumes no consequential warranties or obligations beyond repair or replacement of the above unit.

In all orders for service, please include a description of the failure and a diagram of the test conditions that will allow the factory to reproduce the failure symptoms.

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SECTION I GENERAL INFORMATION

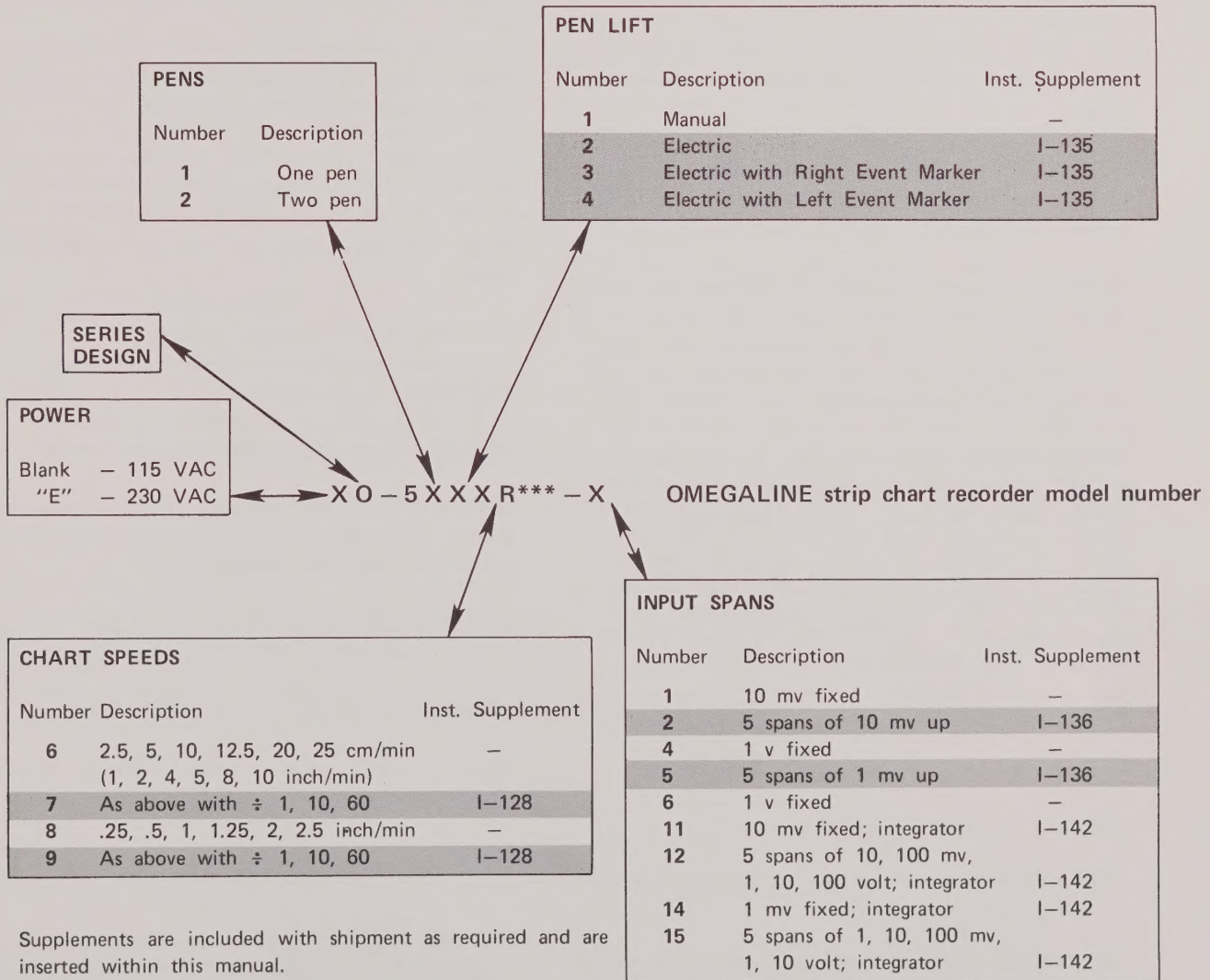
1.1 INTRODUCTION

The **OMEGALINE** Strip Chart Recorder is a rugged, compact, state-of-the-art strip chart recorder. Operationally, the recorder is a potentiometric servo system utilizing an interchangeable input preamplifier, servo amplifier, positioning motor and a feedback transducer (U.S. Patent No. 3,668,672) to control pen position and feedback for the pen axis. Chart movement is derived from a stepper motor that is driven from a precision, built-in oscillator that is independent of power line frequency and offers the advantage of easy field adjustment to Metric or English scaling.

1.2 EXPLANATION OF THE OMEGALINE MODEL NUMBER

A wide range of dc parameters vs time measurements can be made with this recorder because of the many configurations currently available.

Model description and manual coverage is shown below. This manual is basic to all recorders. White areas signify a standard instrument and shaded areas show the available options.



Supplements are included with shipment as required and are inserted within this manual.

*** Suffix "R" indicates Remote

1.3 SPECIFICATIONS

PEN (Y) AXES

MECHANISM: DC potentiometric servo with infinite resolution non-contacting rebalance element.

INPUT CHARACTERISTICS: Isolated and floating to ± 200 volts.

DC INPUT RANGE: Fixed 10 MV full-scale (standard options of decade attenuator and 1 MV span).

INPUT RESISTANCE: Fixed range: > 100 megohms balanced or unbalanced.

Multi-span units: 1 megohm fixed both balanced and unbalanced.

ZERO SET: $\pm 110\%$ of full-scale with ten turn control.

ZERO CHECK (Multi-span units only): Verifies position and allows precise measurement of zero signal without disconnecting or shorting input signal.

RESPONSE: $\frac{1}{2}$ second to 90% of full-scale for both 10 MV and 1 MV, nominal.

WRITING SPEED: 20 in/sec (50 cm/sec) nominal. Independent of line frequency.

INTERFERENCE REJECTION: For a maximum error of 0.1% of full-scale on most sensitive range of 10 MV (in addition to overall accuracy specification).

DC common mode — 120 db

AC common mode — 20 volts RMS at power line frequency (± 120 db).

AC normal mode — 100% of span at power line frequency (> 60 db).

REPEATABILITY (Dead Zone): $\pm 0.1\%$ of full-scale.

LINEARITY: $\pm 0.2\%$ of full-scale.

OVERALL ACCURACY: $\pm 0.3\%$ of full-scale.

OVERSHOOT: Critically damped. 1% typically. Max of 2% on full-scale steps.

PEN OFFSET (Two Pen Units): 0.5 inch (or 15 mm).

WARMUP: Instant response. Typically 5 to 15 minutes for rated accuracies.

CHART (X) AXIS

MECHANISM: Digital stepper motor driving web feed, self-aligning, paper drive. Step size 0.00167 inches nominal. Maximum steps per second of 100.

RECORDING WIDTH: 10.0 inches (250 mm) $\pm 3\%$.

CHARTS: Either 11" wide x 100' or 297 mm x 30 m without modification.

CHART SPEEDS: Switch selectable with instant response. Speeds depend upon instrument type. Internally adjustable for type of paper grid (English or Metric).

CHART SPEED ACCURACY: Factory supplied at 0.1% or better. May be field adjusted.

GENERAL

PENS: Disposable fibre tip with self-contained ink supply.

PEN LIFT: Manual (electric optional).

MOUNTING: Bench.

WEIGHT: Averages 22 pounds (10 Kilos).

CONSTRUCTION: All solid state electronics. Anodized, painted aluminum, stainless steel and molded plastic. Permanently lubricated bearings.

ENVIRONMENTAL: Operating within stated accuracy: 10–35°C and 40 to 95% relative humidity at 30°C dry bulb. Storage: –10 to 60°C, 0 to 100% (non condensing) relative humidity at 30°C dry bulb.

POWER: 115/230 VAC $\pm 10\%$, 50–60 Hz. 50 volt amperes on single pen; 70 volt amperes on two pen.

ACCESSORIES SUPPLIED

Two black and two red cartridges per channel, one roll of appropriate chart paper, tear bar, instruction manuals, and warranty application. Also included is a copy of the latest Omega edition of the NBS Temperature-Millivolt Conversion Tables for Thermocouples.

SECTION II OPERATION

2.1 INTRODUCTION

This section contains unpacking information and operating information for the **OMEGALINE** Strip Chart Recorder. Included is a detailed description of the recorder operator controls, signal input terminal requirements and connection, an operational check which verifies satisfactory operation of the recorder, and power connections.

2.2 UNPACKING

The recorder is packed in a specially designed container to give maximum protection during transit and storage.

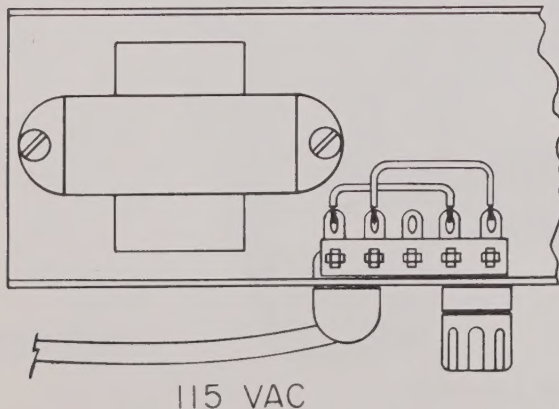
Immediately upon removal from the shipping container, check the recorder for apparent shipping damage such as broken knobs, dented case, etc. If damage exists, contact the carrier for corrective action. If any problem is encountered in operating the recorder, contact OMEGA ENGINEERING directly. Include model number and serial number when referring to the recorder for any reason.

2.3 POWER CONNECTIONS

CAUTION

Make sure power cord is disconnected.

The input power transformer has dual primaries allowing for either 115 VAC or 230 VAC operation over a 45 to 65 Hz. frequency range. A terminal strip is located next to the transformer allowing jumper tie points for connection in parallel (115 VAC) or series (230 VAC) (See Figure 2-1). Change from one to the other requires a soldering iron, removal of the bottom and about 10 minutes of careful work.



CAUTION

When changing, also modify instrument model number on the serial plate to eliminate any confusion.

2.4 SIGNAL INPUT REQUIREMENTS AND CONNECTIONS

2.4.1 GENERAL

The input signal should be free from ac hum and noise. Even though an efficient input filter is installed, an excessive level of ripple or noise at the input can cause errors in the record or jitter in the trace.

All ranges have overload protection to 200 volts. Therefore voltage magnitude and polarity need not cause concern when connecting. On an unknown signal, simply connect and use the zero control and optional attenuator to establish magnitudes and polarities.

With open input the recorder will tend to hum. This is due to the high input resistance and high frequency response of the unit. Extended periods could reduce life. Either shunt input or turn recorder off. Models with input attenuators can be set to zero check.

With normal input lead connection the recorder has positive going response i.e., an increasing signal drives the pen up scale and vice versa. There are certain applications where the signal is inverted from the trace presentation desired. Hence, the recorder needs negative going response, or as the signal increases, the trace decreases. This is easily accomplished by simply reversing input leads. There will be a slight degradation in ac common-mode rejection (the recorder has floating input and a nearly symmetrical input impedance to ground, unbalanced slightly by a 0.01 mfd. capacitor from the (-) terminal to earth ground.

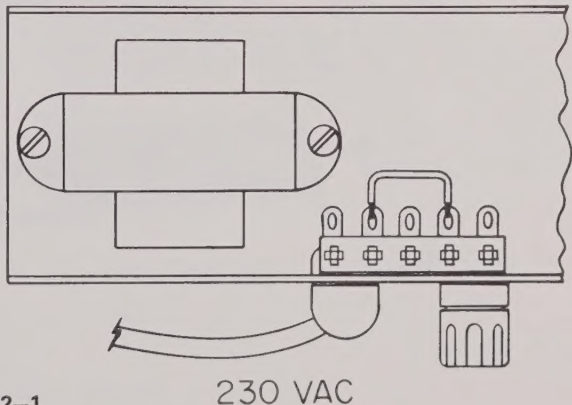


FIGURE 2-1
115/230 POWER CONNECTIONS

Popular Chart Paper

Each roll is 11 inches wide by 100 feet long. Four rolls are packaged to a box with six boxes to a carton (24 rolls).

Types		Time Axis		Amplitude Axis			Numbering
Continuous	Perforated Every 8½"	Major Divisions Every	Minor Divisions Per Major	Grid Width	Major Divisions	Minor Divisions	
EC-0	ECP-0	1 In.	None	Blank	None	None	None
EC-100	ECP-100	1 In.	5	10 In.	10	100	0-10
EC-101	ECP-101	1 In.	6	10 In.	10	100	0-10
EC-102	ECP-102	1 Cm.	6	25 Cm.	25	250	None
EC-103	ECP-103	1 Cm.	6	25 Cm.	10	100	0-10
EC-104	ECP-104	1 Cm.	6	25 Cm.	10	100	None
EC-106	ECP-106	1 In.	6	10 In.	10	100	None

Continuous roll paper can be torn at any length using the tear bar on the recorder.

Perforated paper reduces to a standard paper size of 8½" x 11" or 11" x 17" and can be torn when removed from recorder. It may also be fan folded to improve display. Consult factory for prices.

PENS

Specify	Contents
P-69	Four nylon black
P-70	Four nylon red
P-71	Four nylon green
P-72	Four nylon blue
P-68	1 each of 4 different colors nylon
P-65*	*Two red, two black nylon
P-77	Four dacron red
P-78	Four dacron black
P-79	Four dacron green
P-80	Four dacron blue

*Type originally supplied with recorder

Pens — Snap-on, disposable unit includes pen tip and ink. Sold only in packages of four cartridges. Fits both one and two pen recorders. Nylon fiber tip for general purpose. Dacron fiber for fine trace.

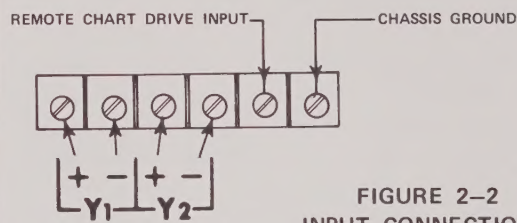


FIGURE 2-2
INPUT CONNECTIONS

terminals Y1 and Y2 provide input points for two pen units. For single pen operation use only the Y1 input.

2.5 OPERATION

This section explains the function of all operator controls. Before operating the recorder it is suggested that the operator become familiar with the controls, paper loading and pen installation. Refer to Figure 2-3 and Table 2-1.

2.4.2 SIGNAL CONNECTION

The Y axis signal input connections are located on the bottom of the recorder (See Figure 2-2). Two sets of

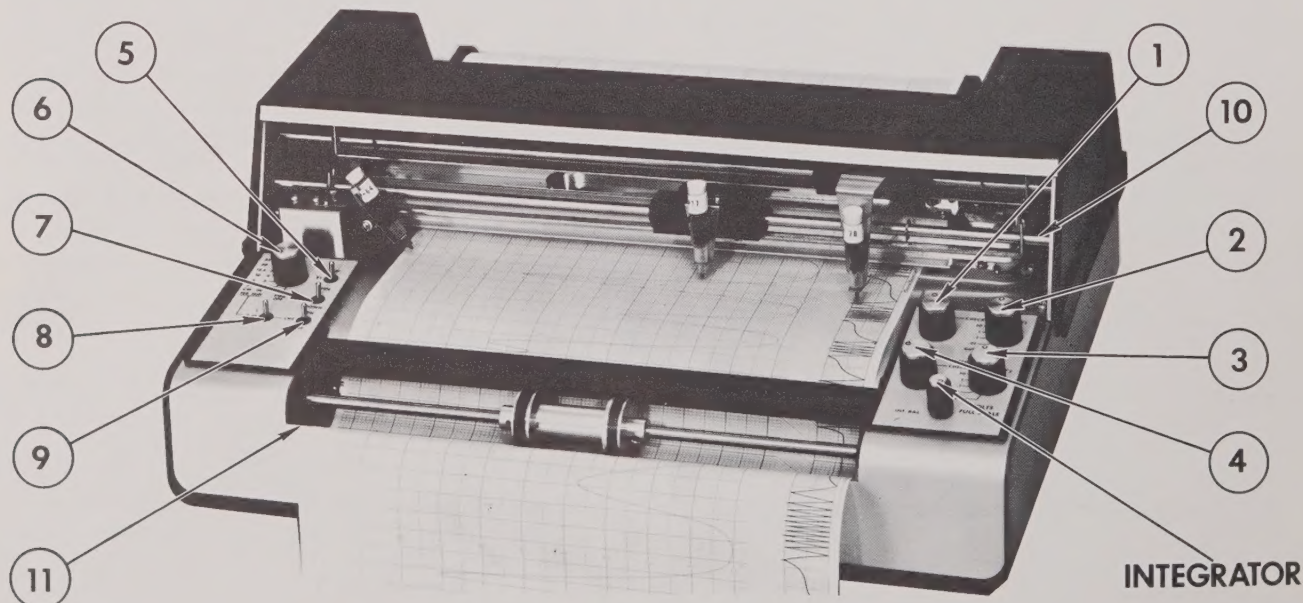


FIGURE 2-3 OPERATOR CONTROLS

**TABLE 2-1
OPERATOR CONTROL FUNCTIONS**

REF. NO.	NAME	FUNCTIONS
1.	Y1 Zero	Adjustable control used to position the recorder pen (Y1) to a desired zero position.
2.	Y1 Volts full-scale (optional)	Five position rotary switch to select the full-scale voltage range. The CHECK position allows for actual zero setting without removing the input signal.
3.	Y2 Volts full-scale and integrator select (optional)	Same as Ref. No. 2, with a sixth position for selection of the integrator mode.
4.	Y2 Zero (optional)	Adjustable control to position the optional pen to a desired zero position.
5.	Y1 Up/Down (optional)	A two position toggle switch used to raise and lower the pen.
6.	Chart speed selector.	Contains the PWR ON/OFF. Provides for selection of 6 different chart speeds. It is calibrated in CM/MIN and/or IN/MIN depending on model of recorder.
7.	Y2 Up/Down (optional)	A two position toggle switch used to raise and lower the optional pen.
8.	$\div 1, 10, 60$ (optional)	A three position toggle switch used to increase the number of basic chart speeds providing 17 chart speeds.
9.	CHT ON/OFF	A two position toggle switch used to START/STOP chart movement.
10.	Manual pen lift lever	Raises and lowers pens to make contact with chart paper.
11.	Tear bar	A convenient way to detach the record.

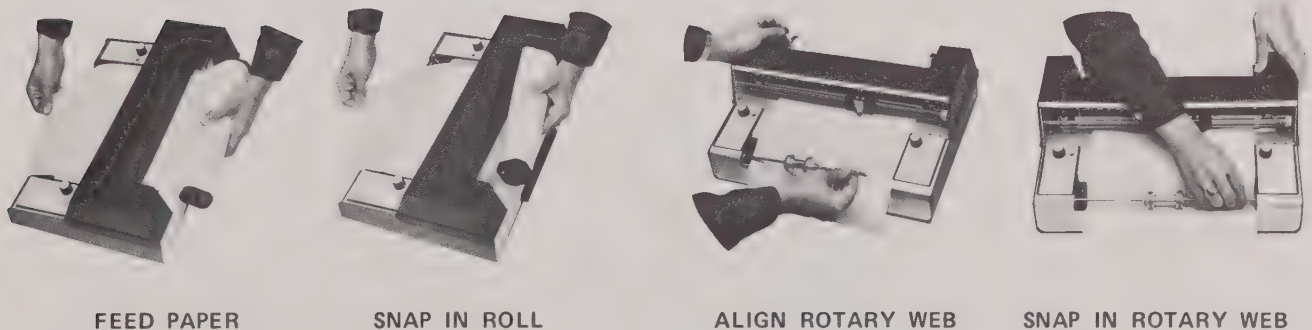


**FIGURE 2-4
PAPER LOADING**

2.6 PEN

The recorder uses disposable nylon tipped pens, eliminating the need for pen filling or cleaning. Insert the pen until the pen flange is against the bottom of the pen holder and then snap into the clip. If the pen has been exposed for some weeks and will not write, simply hold it under running water for a minute. Occasionally rub across a paper surface to help it start.



FIGURE 2-5
PENS

2.7 OPERATING CONSIDERATIONS

After loading paper and pens the recorder is ready to operate. Lift tear bar as shown in Figure 2-6.

- **POSITIVE PAPER FEED** will work well on a level surface until 10–15 feet of paper have been fed out. The paper will then tend to fold back on the recorder. If longer traces are desired, position the recorder at a surface edge and let the paper feed to the floor. No weights or pulls are necessary.
- **TO TEAR OFF PAPER** move tear bar to the active position (See Figure 2-6) press finger firmly on center of the tear bar and briskly tear.
- Chart speeds on the combination instruments (Models O-5XX6-X and O-5XX7-X are double labeled on the selector in both English and Metric speeds. One setting is precise, the other approximate (1.6% off). Without an initial stated preference the recorder comes with Metric speeds precisely set. The unit can be adjusted for

precise English units very easily (See Section 4.3.8). However, just one is precisely correct at a time. Most users simply tape over the scaling not used.

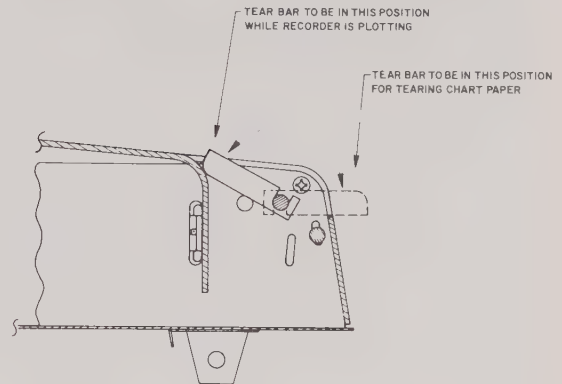


FIGURE 2-6
TEAR BAR LOCATION FOR 5000 RECORDER

- **TO ADVANCE PAPER** for trace removal there are three choices.
 - (1) Run the chart at maximum speed.
 - (2) The drive web roller may be removed and the paper pulled forward.
 - (3) The paper may be grasped and simply pulled out. This method is the most convenient and will not harm the recorder.
- **OFF SCALE NOISE** will last for approximately 5 seconds calling audible attention. The pen then is muted as long as the out-of-scale signal persists. It instantly recovers as the signal comes within scale.
- **PEN OFFSET** (two pen units only) is set for 15 mm on Models (O-52X6-X and O-52X7-X) and 0.5 inch in Models (O-52X8-X and O-52X9-X). The outer pen may be easily set for the desired offset by removing the hood and resetting the two obvious holding screws on the pen holder.
- **TEMPERATURE AND HUMIDITY** — Maximum accuracy with linear results is achieved only if any paper environment is kept relatively constant during the entire length of recording. Typically, a 10°C change can cause as much as 1% change in paper dimensions (i.e., the paper shrinks and expands with changes in temperature and humidity), leading to a 1% error in recording accuracy.

SECTION III
THEORY OF OPERATION
(Covering Serial/Number C6824-001 and Up)

3.1 GENERAL

In broad concept the OMEGALINE recorder is a potentiometric servo system utilizing an input preamplifier, servo amplifier, positioning motor, and position feedback transducer for the pen axis. The transducer (U.S. Patent No. 3668672) is a unique design which uses a linear non-contact capacitance measurement technique. The belt which drives the pen serves three functions: pen positioning, slip clutch and active feedback element. It is the center plate of an active three plate capacitor and acts as a grounded, moving shield between the two stationary elements. One of the stationary plates is driven by a precision 10.56 khz square wave source, and the other plate is connected to a buffer amplifier. The output of the buffer amplifier is a 10.56 khz square wave with amplitude proportional to pen displacement. This square wave signal is then demodulated to provide a dc error signal to drive the dc servo motor, which in turn moves the pen to the proper null position. The output of the demodulator also provides feedback (via modulator) to drive the input of the buffer amplifier to a virtual ground.

Chart paper is moved by a stepper motor preceded by an Integrated Circuit (IC) divider coupled to a rotary selector switch. Basic timing frequency is derived from a built-in clock rather than from line frequency. The advantages are twofold: first is the field ability to adjust chart movement for English or Metric units; second, the recorder operates independently of power line frequency.

Each pen has its own power supply using a conventional transformer, rectifier, and series regulator circuit. The stepper drive derives its current from the Y1 amplifier supply.

3.2 DETAILED THEORY (See Figure 3-2)

Preamplifier

The input signal is applied to a two section RC filter which acts as a line noise and interference filter.

One of two interchangeable preamplifier boards (10 MV full-scale or 1 MV full-scale) are used prior to the Servo Amplifier to increase the recorders input

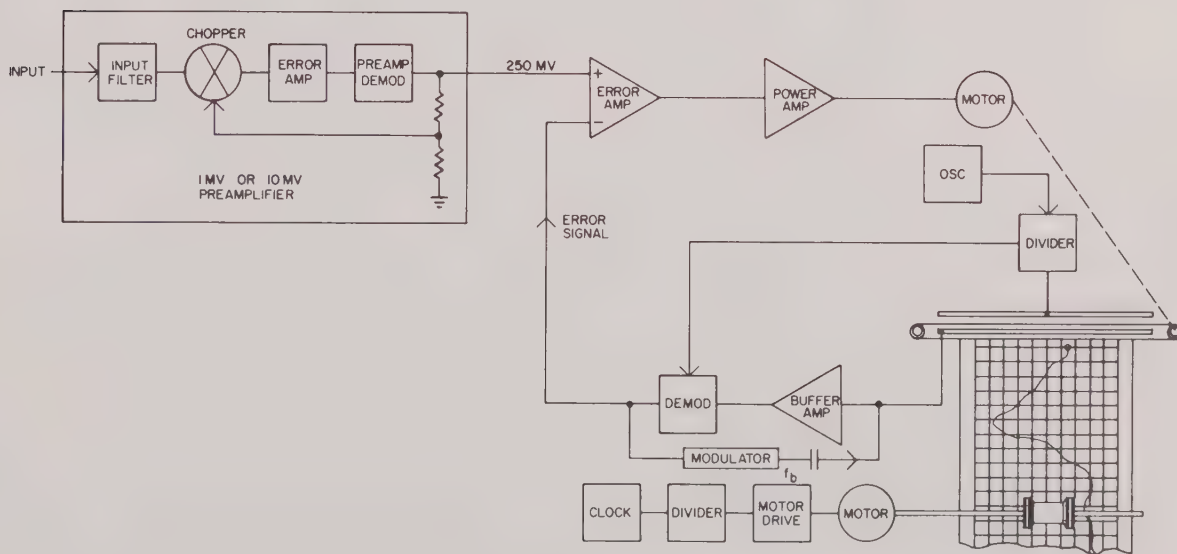
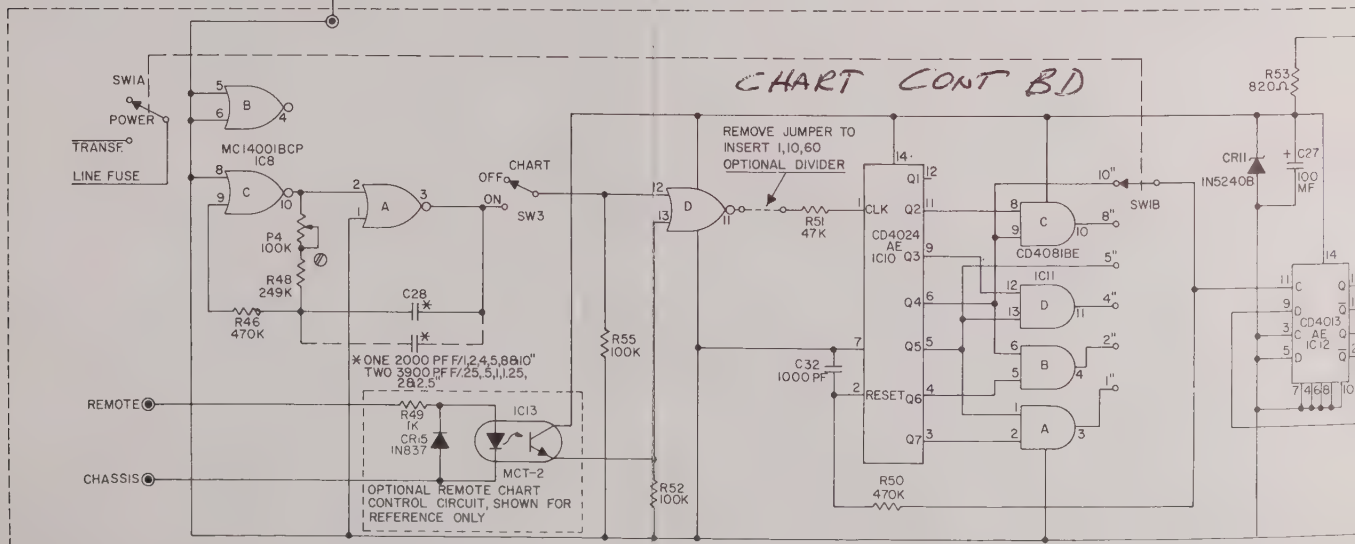
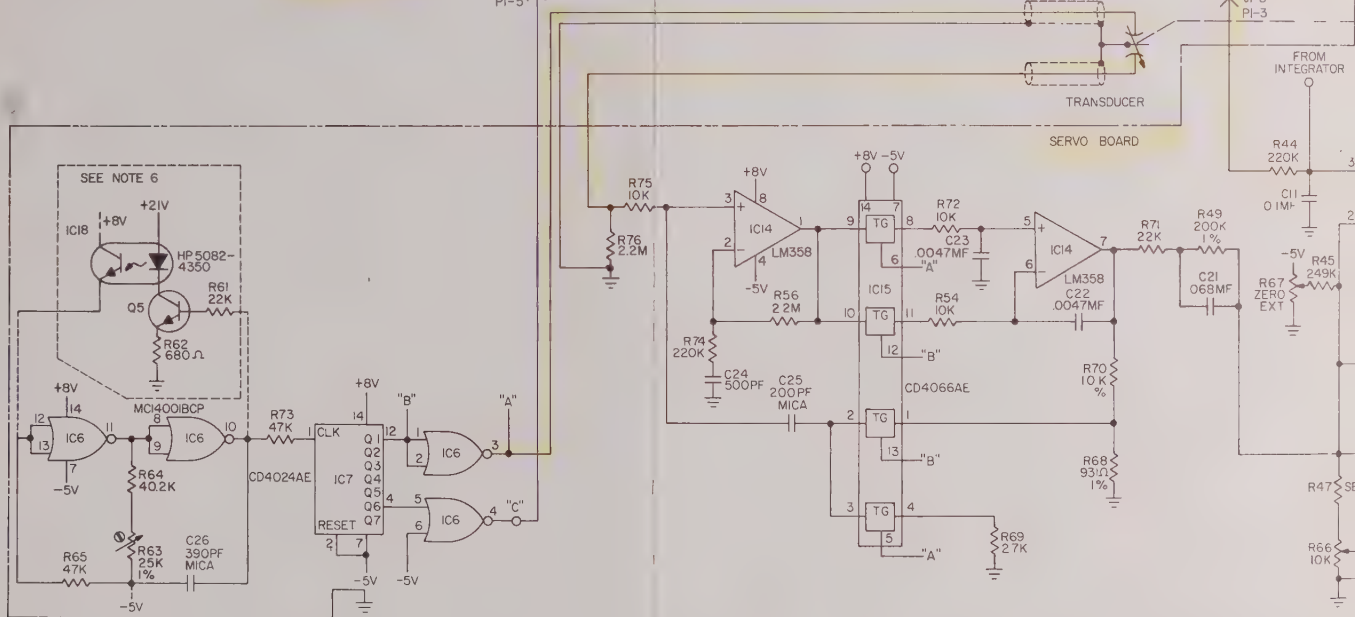
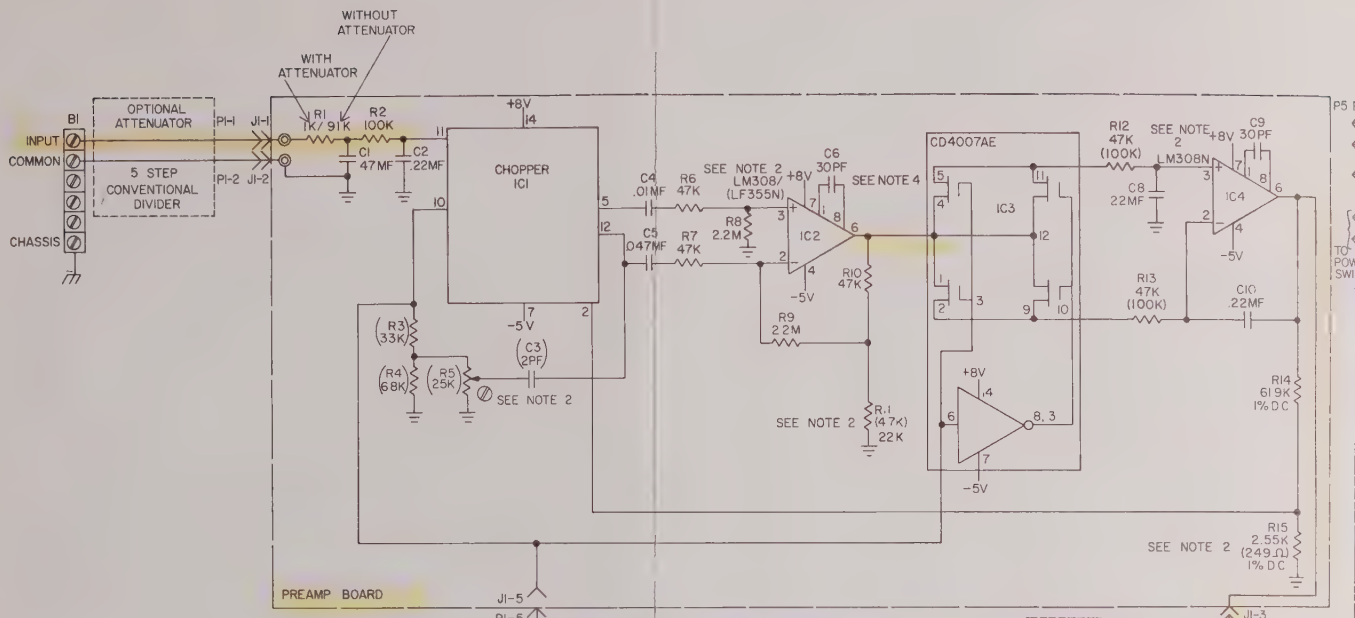
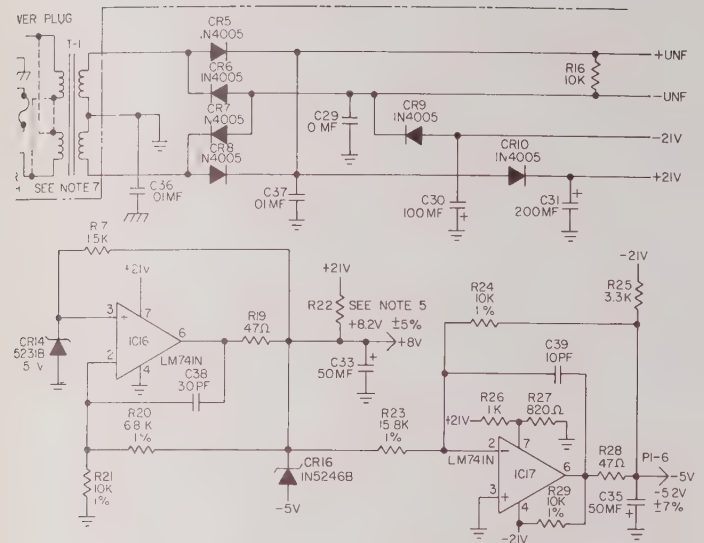


FIGURE 3-1
FUNCTIONAL BLOCK DIAGRAM







sensitivity. Both preamplifiers are adjusted to give a full-scale output of 250 millivolts to be applied to the servo amplifier.

The low level input signal is fed to a MOSFET chopper IC1 which compares the incoming signal to a self-generated dc voltage that is developed at IC1 pin 2 which is different from the incoming signal (IC1 pin 11), an ac signal will appear at Capacitors C4 and C5 with an amplitude equal to the difference between the incoming signal and the voltage at IC1 pin 2. This ac signal (330 Hz) derived from IC6 pin 4 is amplified by a factor of 40 for a 10 millivolt preamp or 440 for a 1 millivolt preamp by the integrated circuit IC2.

The output of IC2 feeds through the demodulator circuit IC3 and differential amplifier IC4 restoring the dc signal with correct polarity.

Servo Amplifier

The output signal from the preamplifier is fed to the non-inverting input of the servo output amplifier IC5. The inverting input of IC5 is a summing point for the zero control voltage, pen position feedback signal and the servo amplifier feedback signal. The output of IC5 drives the servo motor via Darlington transistors Q3 and Q4. When the voltage at IC5 pin 6 exceeds 6V for about one second either Q1 or Q2 will turn on reducing the motor drive to about 2.5 volts. This drive is sufficient to cause a slow rotation of the motor. Recovery is essentially instantaneous with the removal of the overdrive condition. As mentioned in Section 3.1 the servo motor positions a feedback transducer whose output is connected to pin 3 of IC14. Any signal present at pin 3 will be balanced out to zero by negative feedback through capacitor C25; thus, pin 3 is a null junction (signal at pin 3 is always zero). The output of IC14 (pin 7) passes through a lead network (R71, R49 and C21) which controls the servo system damping.

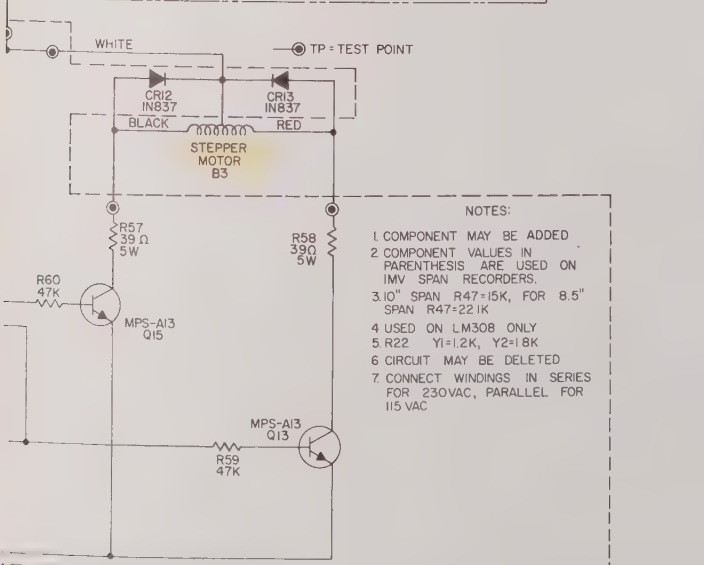
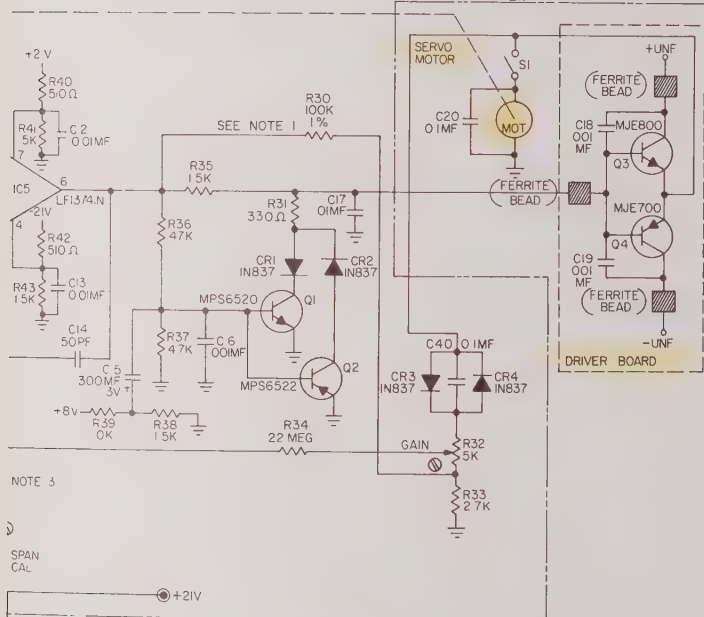


Chart Drive

Chart drive is accomplished with an Oscillator (IC8), Counter/decoder (IC10 and IC11) and stepper motor circuits (IC12, Q13 and Q15). Optional speed dividers and remote inputs are also available.

Power Supply

Power supply voltage to operate the recorder is provided by two unregulated supplies, yielding plus and minus 21 volts. Regulated plus eight volts is accomplished by the circuit consisting of IC16 and zener diode CR14. Negative five volts is achieved by OP - amp IC17. Chart drive voltages are derived by the 10 volt shunt regulator made up of CR11, R53 and C27.

SECTION IV MAINTENANCE

4.1 GENERAL

This section contains instructions for trouble localization, repair, calibration and final testing of the OMEGALINE recorder.

4.1.1 ACCESS

To expose any part of the recorder, the hood must first be removed by unscrewing the two flat head screws located on either side. The hood then lifts off.

NOTE

Two pen units have two phillips screws at the rear that must be removed.

The bottom cover is removed by pulling off four clips located on the instrument feet. This is best done with the instrument resting on its rear. The bottom cover then folds down and the instrument is fully exposed without actually removing the bottom from the power cord.

There are several precautions to be observed when removing the bottom cover:

1. With the bottom removed and power connected there is power line voltage on the stepper driver switch and in the power transformer area. Use care when working in this area.
2. The OMEGALINE recorder has fairly high density construction. You can easily cause damage or failure if adjacent terminals are momentarily short-circuited.

4.1.2 PREAMPLIFIER REMOVAL

To remove and replace the preamplifier, remove the bottom cover, place the recorder on end, carefully remove the preamp board from the servo amplifier by squeezing together the ends of the plastic standoff/fastener and lifting the preamplifier board straight up away from the standoffs and electrical connector.

4.1.3 LUBRICATION

NEVER OIL OR GREASE ANY PARTS, BEARINGS OR SLIDES. All parts are either permanently

lubricated or of low friction design. Adding lubricants actually increases friction by providing a perfect trap for dust or contaminants. If a bearing or race is obviously causing friction or binding, it should be cleaned thoroughly. If still below par in operation, replace, rather than lubricate.

4.1.4 CLEANLINESS

The OMEGALINE is extremely tolerant of dust and contaminants. However, spillage of oil or other liquids could short out the electrical components or seriously affect specified performance.

Should a dirt build-up occur, use alcohol (isopropyl) and cotton swabs. Clean the pen holder slide bars, and the belt drive pulleys. Carefully clean transducer drive belt (5000—359) by holding swab in one position with gentle pressure on belt as the pen holder is pulled from one side to the other. Only the interior side of the belt need be cleaned. Clean motor gear teeth.

NOTE

When cleaning be extremely careful not to sharply bend the transducer belt. DO NOT scratch the outside belt surface.

4.1.5 WEB CLEANING

Carefully clean all portions of the rotary web (5000—477) using soap and water to remove wax, dirt or road film.

4.1.6 INK ON SURFACES

Use a clean rag. Dip in a concentrated solution of soap and water. Squeeze first to avoid excess and then scrub affected surface. Second choice is LAVA soap and water (but be careful as the pumice can scour through the anodizing). DO NOT use any aerosol cleaners, such as TV contact cleaner, household wall cleaners or anything with a solvent.

4.2 TROUBLESHOOTING

Before attempting to troubleshoot the recorder make certain that any span control is in the correct position, input signal is being received and that the signal is proper with no unusual noise. Check to make sure that there is power to the instrument.

SYMPTOM	POSSIBLE TROUBLE	CHECK/REMEDY
Pen won't write.	Cartridge out of ink or dried.	Wet — See Pen (Section 2.6) or replace, if required.
Chart speed incorrect.	Incorrect clock adjustment. Dirty web.	Readjust. Clean.
Paper won't advance.	Alignment pin of web roller out of slot. Paper supply roll out of pivot holes. Switch not engaged. Power supply dead.	Insert properly. Check that paper roll turns freely. Insure that both a speed is selected and the main chart switch actuated. If Y axis works, check stepper driver board.
Recorder dead.	Fuse burn—out. Faulty power supply.	Replace fuse, if it blows again find power supply fault. Check completely starting at primary of transformer.
Y drives to zero or full—scale.	Zero setting incorrect. Reversed input. Overrange signal. Bad amplifier component. Bad motor. Damaged rebalance transducer.	Run zero control full range. Swap input leads. Check for proper input signal level. Trouble shoot amplifier or replace. If voltage at motor, check armature resistance. Replace belt.
Y drifts to zero or full—scale.	Open input. Defective amplifier. Damaged rebalance transducer.	Either shunt input or turn off recorder. Repair or replace. Replace.
Jitter (at all points of trace).	Open signal input. Noisy signal source. Noisy zero control. Noisy component.	Either shunt input or turn off recorder. Disconnect and shunt input. If jitter disappears, fix source. Replace. Fix fault in amplifier.
Jitter (at one point only).	Bad place in zero pot.	Replace.
Excessive dead zone or sluggish frequency response.	Mechanism dirty. Contaminants in servo motor gear train. Bad amplifier component.	Clean, See Section 4.1. Clean, See Section 4.1. Repair or replace.

4.3 PERFORMANCE CHECK

The ability of any strip chart recorder to give excellent performance reduces to several parameters — gain, dead zone (repeatability), calibration, linearity, damping, resetability, and chart time accuracy. All should exhibit stability and tolerance for age and use, and be self compensating. Theoretically, this would yield the perfect instrument with no need for adjustment.

Practically, the **OMEGALINE** is almost ideal. Five parameters meet the perfect criteria. Three adjustments only are needed and these only when components are replaced, or as a basic change is desired in the chart speeds.

The following text explains how to check these parameters and what to do should some component fail. Test equipment consists of a precision source with a decade attenuator, and a low frequency generator (0.1 to 10 Hz.) capable of sine and square wave output.

4.3.1 GAIN

Recorders have gain controls to compensate for variations in amplifier sensitivity, mechanical friction and inertia. The amount of friction is negligible due to the direct coupled drive belt design; however, the adjustment of R32, below the recorder oscillation point, may be necessary. Any lack of gain signifies major troubles and would show up as a major fact under the tests for dead zone and frequency response.

4.3.2 DEAD ZONE (REPEATABILITY)

Defined as the ability of a unit to reproduce a given signal when approached from different directions. With the automatic gain sensing circuit of the **OMEGALINE** this should always be 0.1% of full-scale, or less than the pen trace width. Anything more than this indicates extreme mechanical wear, contaminants, or severe amplifier component degradation—i.e., something is basically wrong.

To check, connect a stable signal centering the pen on the chart (alternately shunt input and use the zero control to center pen). With the chart moving push the pen slightly up or down scale by pressing on the slider block (NOT THE PEN or holder which could deform). When released, the pen should return to within 0.1% of its original position. Repeat in the opposite direction. (See Figure 4-1)

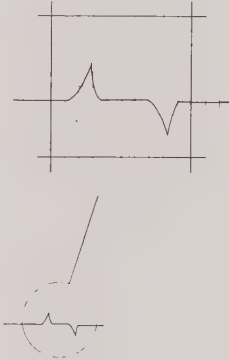


FIGURE 4-1
DEAD ZONE

4.3.3 SPAN CALIBRATION

To check, connect the recorder calibrator or a precision dc voltage source (0.05%) with sufficient range to cover the recorder's span, set at minimum value, and set pen zero to coincide with chart-zero grid margin; then set the source for full-scale span, which should coincide with the paper full-scale grid. (See Figure 4-2)

Don't adjust calibration when the recorder first appears to be operating incorrectly. First, check:

- Input is open — as mentioned before, a high frequency hum can occur due to the recorder's high resistance and frequency response. Shunt the input to check.
- Insure that no noise has been picked up in the signal.
- Check for high level, high speed transients in the signal.



FIGURE 4-2
CALIBRATION

If not correct, adjust the calibration control (R66) which is accessible at the center bottom of the recorder. **DO NOT REMOVE BOTTOM.** Single pen control is toward front of the bottom; second pen is toward rear. (CW increases span, CCW decreases). Once set it should be stable for the application. It should be noted that calibration sources **DO** vary and paper can grow to 1% between different temperature and humidity environments.

4.3.4 LINEARITY

The ideal check is to use a precision source with a decade attenuator to give an increasing staircase function. With precisely set zero and full-scale span any variance from ideal is a check of linearity. (See Figure 4-3)

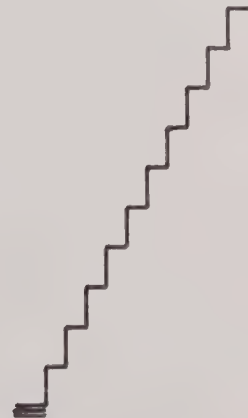


FIGURE 4-3
LINEARITY

4.3.5 DAMPING

Use a square wave generator with an 0.5 Hz. amplitude of 1 inch (2.5 cm) at maximum chart speed. Overshoot should normally not be apparent. Increase amplitude 100% of full-scale when overshoot would normally be no more than 2%. (See Figure 4-4)

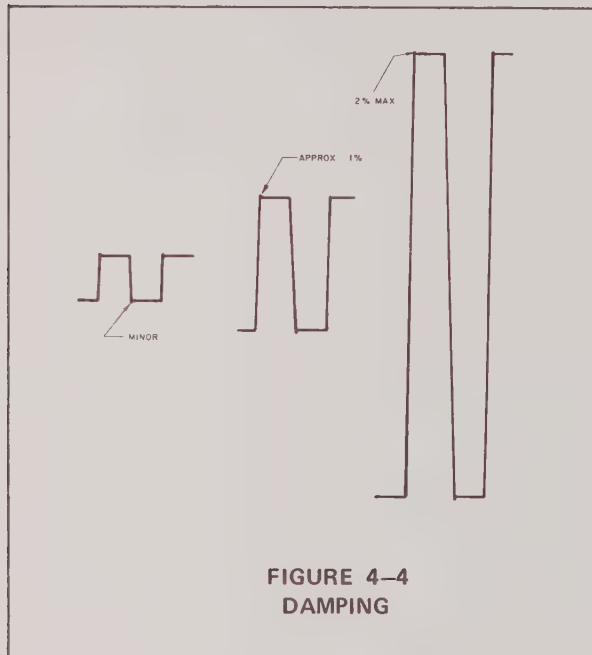


FIGURE 4-4
DAMPING

4.3.6 RESETABILITY

This is the ability to precisely set the pen at a desired value. Simply adjust the zero twice to a given point and check that this can be done within 0.1%. Primarily this is a function of a stable amplifier and smooth mechanics, plus a zero control with adequate resolution. If it cannot be met, check several set points, as the zero control may be bad or have a worn spot requiring replacement.

4.3.7 CHART TIME CALIBRATION

The OMEGALINE recorder uses a precision stepper motor that is synchronized to a built-in clock. This allows for precise setting and gives independence of line frequency rates and variations. A further advantage is the ability to adjust for English or Metric grids.

To check or change chart speed, run chart at maximum speed and using the zero control make a mark noting time. After a given time interval make another mark. Measure trace against speed desired. If not within 0.1% of the desired, adjust the clock (trim pot, P4, located through bottom cover under the speed selector switch (CCW increases speed, CW decreases). The slower speeds are electrically fixed divisions of the max speed and are not adjustable. Should speed vary with time, the web has become dirty and should be cleaned. (See Figure 4-5)

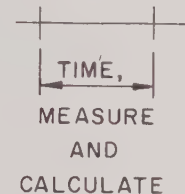


FIGURE 4-5
CHART TIME CALIBRATION

4.3.8 CURRENT OFFSET (1MV Preamp Only)

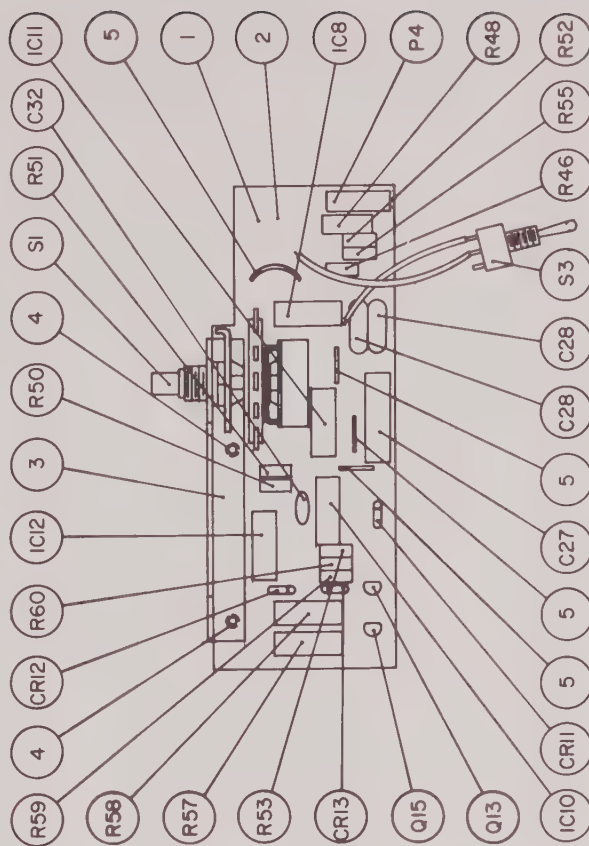
This adjustment is probably never necessary unless the FET chopper is replaced. With max sensitivity of recorder use the zero control to set the pen at approximately mid-scale. Disconnect any source from the input and connect a 100K resistor between the input terminals. Alternately shunt and unshunt this resistor with a jumper or switch, observing pen movement. If any, adjust the current offset pot (R5 available with bottom of recorder removed) until movement is less than 0.05 inch as the resistor is alternately shunted and unshunted.

PARTS LIST

Ref. No.	Part No.	Description
1	5000-469	Assembly - Stepper Driver Board (1-10)
1	5000-473	Assembly - Stepper Driver Board (.25-2.5)
2	5000-468	Drilled - Stepper Driver Board
3	5000-462	Bracket - Rot. Sw.
4	MH-48	Screw
5		Jumper Wire
C27	MC-567	Capacitor - 100MFD-15V-Mallory No. MTA100E15
C28	MC-180	Capacitor - 200PFD-5%-Mica (For 1-10)
C28	MC-387	Capacitor - 3900PFD-5%-Mica (For .25-2.5)
C32	MC-579	Capacitor - 1000PFD-20%-Ceramic
CR11	MD-142	Diode - 1N5240B
CR12	MD-8	* Diode - 1N837
CR13	MD-8	* Diode - 1N837
IC8	MW-283	Integrated Circuit - MC140018CP
IC10	MW-292	Integrated Circuit - CD4024AE
IC11	MW-293	Integrated Circuit - CD4081BE
IC12	MW-239	Integrated Circuit - CD4013AE
P4	MP-461	Potentiometer - 100K-Beckman No. 89WR 100K
Q13	MQ-92	Transistor - MPS-AB
Q15	MQ-92	Transistor - MPS-AB
R46	MR-145	Resistor - 470K-1/3W-5%-Carbon Film
R48	MR-260	Resistor - 249K-1/2W-1%-Metal Film
R50	MR-145	Resistor - 470K-1/3W-5%-Carbon Film
R51	MR-964	Resistor - 47K-5%-Carbon Film
R52	MR-310	Resistor - 100K-1/3W-5%-Carbon Film
R53	MR-1078	Resistor - 820 Ohm-1/3W-5%-Carbon Film
R55	MR-310	Resistor - 100K-1/3W-5%-Carbon Film
R57	MR-1333	Resistor - 39 Ohm-5W-5%-W.W.
R58	MR-1333	Resistor - 39 Ohm-5W-5%-W.W.
R59	MR-964	Resistor - 47K-1/3W-5%-Carbon Film
R60	MR-964	Resistor - 47K-1/3W-5%-Carbon Film
S1	MS-174	Switch - CTS Southwest No. SW2883
S3	MS-351	Switch - Alco No. MTA-106D

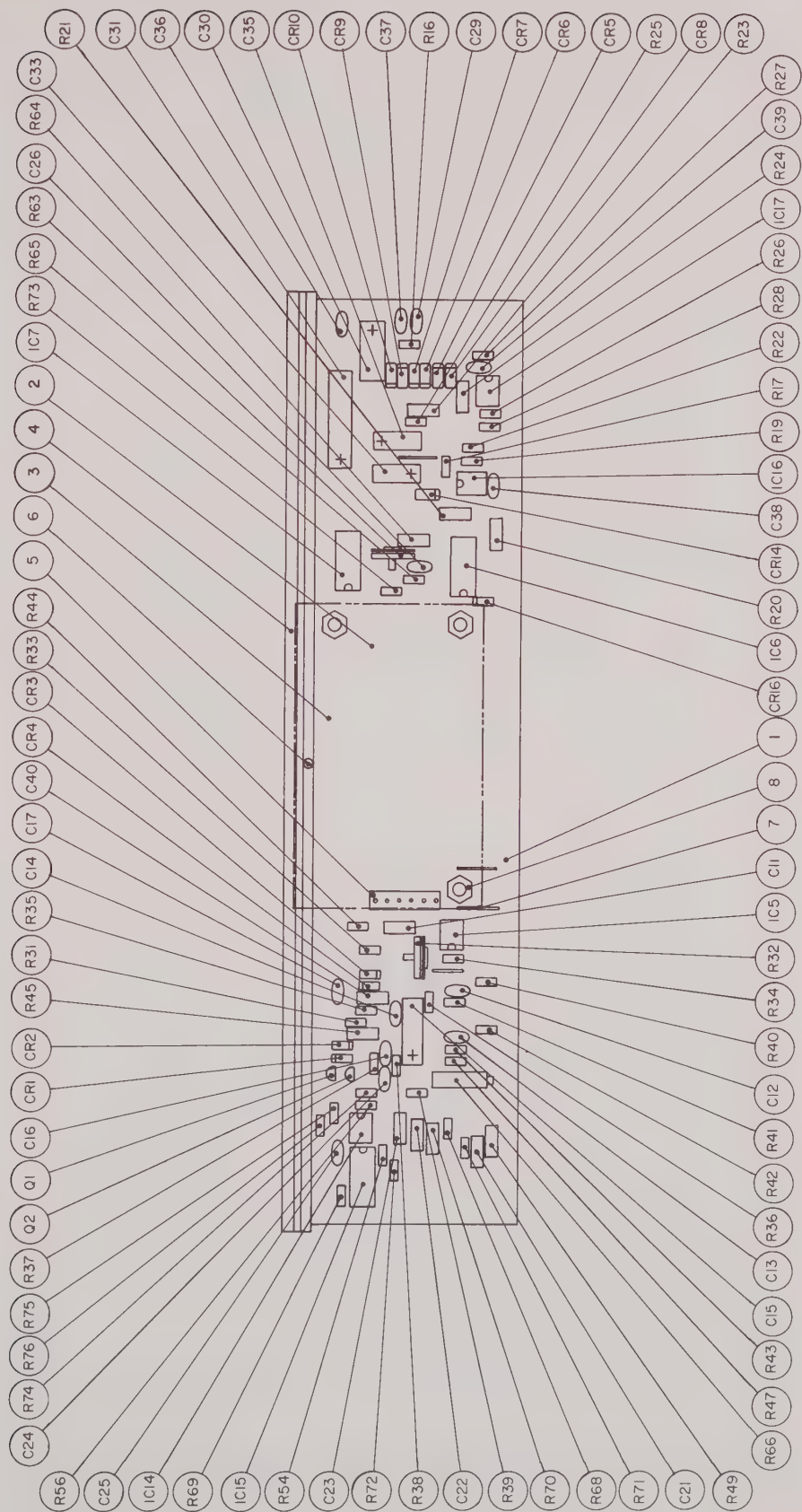
* Depends on model number.

1-2-4-5-8-10 COMPLETE ASSEMBLY IS PART NO. 5000-469
2.5-5-10-12.5-20-25 COMPLETE ASSEMBLY IS PART NO. 5000-473



PARTS LIST

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1	5000-496	Amplifier Board Assembly	IC17	MW-323	Integrated Circuit - LM741CN-Natl.
2	5000-495	Amplifier Board Drilled	Q1	MQ-26	Transistor - MPS6520-Motorola
3	5000-493-1	Preamp Board, 1MV Assembly	Q2	MQ-27	Transistor - MPS6522-Motorola
4	5000-500-1	Board Mount	R16	MR-470	Resistor - 1/3W-Carbon Film
5	MC-1143	Connector - Male, 6 Ckt. Molex 09-64-1062	R17	MR-483	Resistor - 1.5K-1/3W-5%-Carbon Film
6	MH-64	Screw - Self Tapping	R19	MR-982	Resistor - 47 Ohm-1/3W-5%-Carbon Film
7		Jumper Wiring	R20	MR-213	Resistor - 6.81K-1/2W-1%-Metal Film
8	MS-442	Standoff - 1/4" Richo TCBS-4N	R21	MR-974	Resistor - 10K-1/2W-1%-Metal Film
C11	MC-381	Capacitor - 0.1MF-Met. Mylar-±10%-Plessey 160.1K-100C	R22	MR-185	On Y1 Only Resistor - 1.2K-1/3W-5%-Carbon Film
C12	MC-229	Capacitor - 0.01MF-Ceramic-100V-Sprague TG-S10	R22	MR-839	On Y2 Only Resistor - 1.8K-1/3W-5%-Carbon Film
C13	MC-229	Capacitor - 0.01MF-Ceramic-100V-Sprague TG-S10	R23	MR-1019	Resistor - 15.8K-1/2W-1%-Metal Film
C14	MC-383	Capacitor - 50PF-Ceramic-±20%-1KV	R24	MR-974	Resistor - 10K-1/2W-1%-Metal Film
C15	MC-1161	Capacitor - 300MF-3V-Mallory TT3X300A	R25	MR-978	Resistor - 3.3K-1/3W-5%-Carbon Film
C16	MC-579	Capacitor - 0.001MF-Ceramic-±20%-1KV	R26	MR-963	Resistor - 1K Ohm-1/3W-5%-Carbon Film
C17	MC-229	Capacitor - 0.01MF-Ceramic-100V-Sprague TG-S10	R27	MR-1078	Resistor - 820 Ohm-1/3W-5%-Carbon Film
C21	MC-384	Capacitor - 0.068MF-Met. Mylar-±10%-Plessey 160.068K250C	R28	MR-982	Resistor - 47 Ohm-1/3W-5%-Carbon Film
C22	MC-379	Capacitor - 0.0047MF-Met. Mylar-±10%-Plessey 160.0047K630C	R31	MR-822	Resistor - 330 Ohm-1/3W-5%-Carbon Film
C23	MC-379	Capacitor - 0.0047MF-Met. Mylar-±10%-Plessey 160.0047K630C	R32	MP-474	Potentiometer - 5K-Carbon-CTX201-5K
C24	MC-468	Capacitor - 500PF-Ceramic-±20%-1KV	R34	MR-1217	Resistor - 22Meg-1/3W-5%-Carbon Film
C25	MC-564	Capacitor - 200PF-Dipped Mica-±5%	R35	MR-483	Resistor - 1.5K-1/3W-5%-Carbon Film
C26	MC-462	Capacitor - 390PF-Dipped Mica-±5%	R36	MR-964	Resistor - 47K-1/3W-5%-Carbon Film
C29	MC-229	Capacitor - 0.01MF-Ceramic-100V-Sprague TG-S10	R37	MR-979	Resistor - 4.7K-1/3W-5%-Carbon Film
C30	MC-340	Capacitor - 100MF-25V-Alum. Elec.-C.D. NLW50-16 or Equiv.	R38	MR-483	Resistor - 1.5K-1/3W-5%-Carbon Film
C31	MC-1148	Capacitor - 200MF-25V-Alum. Elec.-C.D. NLW200-25 or Equiv.	R39	MR-470	Resistor - 10K-1/3W-5%-Carbon Film
C33	MC-1147	Capacitor - 50MF-16V-Alum. Elec.-C.D. NLW50-16 or Equiv.	R40	MR-1205	Resistor - 510 Ohm-1/3W-5%-Carbon Film
C35	MC-1147	Capacitor - 50MF-16V-Alum. Elec.-C.D. NLW50-16 or Equiv.	R41	MR-483	Resistor - 1.5K-1/3W-5%-Carbon Film
C36	MC-200	Capacitor - 0.01MF-Ceramic-±20%-1KV	R42	MR-1205	Resistor - 510 Ohm-1/3W-5%-Carbon Film
C37	MC-229	Capacitor - 0.01MF-Ceramic-100V-Sprague TG-S10	R43	MR-483	Resistor - 1.5K-1/3W-5%-Carbon Film
C38	MC-395	Capacitor - 30PF-Ceramic-±20%-1KV	R44	MR-818	Resistor - 220K-1/3W-5%-Carbon Film
C39	MC-156	Capacitor - 10PF-Ceramic-±20%-1KV	R45	MR-260	Resistor - 215K-1/2W-1%-Metal Film
C40	MC-381	Capacitor - 0.1MF-Met. Mylar-±10%-Plessey 160.1K100C	R47	MR-238	ON NON-Integrator Rec. Resistor - 15K-1/2W-1%-Metal Film
CR1	MD-8	Diode - 1N837	R47	MR-1329	ON Integrator Rec. Resistor - 22.1K-1/2W-1%-Metal Film
CR2	MD-8	Diode - 1N837	R49	MR-409	Resistor - 200K-1/2W-1%-Metal Film
CR3	MD-8	Diode - 1N837	R54	MR-470	Resistor - 10K-1/3W-5%-Carbon Film
CR4	MD-8	Diode - 1N837	R56	MR-980	Resistor - 2.2Meg-1/3W-5%-Carbon Film
CR5	MD-25	Diode - 1N4005	R63	MP-454	Potentiometer - 25K-Carbon-CTS X201-25K
CR6	MD-25	Diode - 1N4005	R64	MR-518	Resistor - 40.2K-1/2W-1%-Metal Film
CR7	MD-25	Diode - 1N4005	R65	MR-964	Resistor - 47K-1/3W-5%-Carbon Film
CR8	MD-25	Diode - 1N4005	R66	MP-152	Potentiometer - 10K-Cermet Dale 783-10K
CR9	MD-25	Diode - 1N4005	R68	MR-1327	Resistor - 931 Ohm-1/2W-1%-Metal Film
CR10	MD-25	Diode - 1N4005	R69	MR-482	Resistor - 2.7K-1/3W-5%-Carbon Film
CR14	MD-113	Diode - 1N5231B	R70	MR-974	Resistor - 10K-1/2W-1%-Metal Film
CR16	MD-145	Diode - 1N5246B	R71	MR-178	Resistor - 22K-1/3W-5%-Carbon Film
IC5	MW-373	Integrated Circuit - FL13741N-Natl.	R72	MR-470	Resistor - 10K-1/3W-5%-Carbon Film
IC6	MW-283	Integrated Circuit - MC14001BCP-Moto	R73	MR-964	Resistor - 47K-1/3W-5%-Carbon Film
IC7	MW-292	Integrated Circuit - CD4024CN-Natl.	R74	MR-818	Resistor - 220K-1/3W-5%-Carbon Film
IC14	MW-246	Integrated Circuit - LM358N-Natl.	R75	MR-470	Resistor - 10K-1/3W-5%-Carbon Film
IC15	MW-327	Integrated Circuit - CD4066CN-Natl.	R76	MR-980	Resistor - 2.2Meg-1/3W-5%-Carbon Film
IC16	MW-323	Integrated Circuit - LM741CN-Natl.			

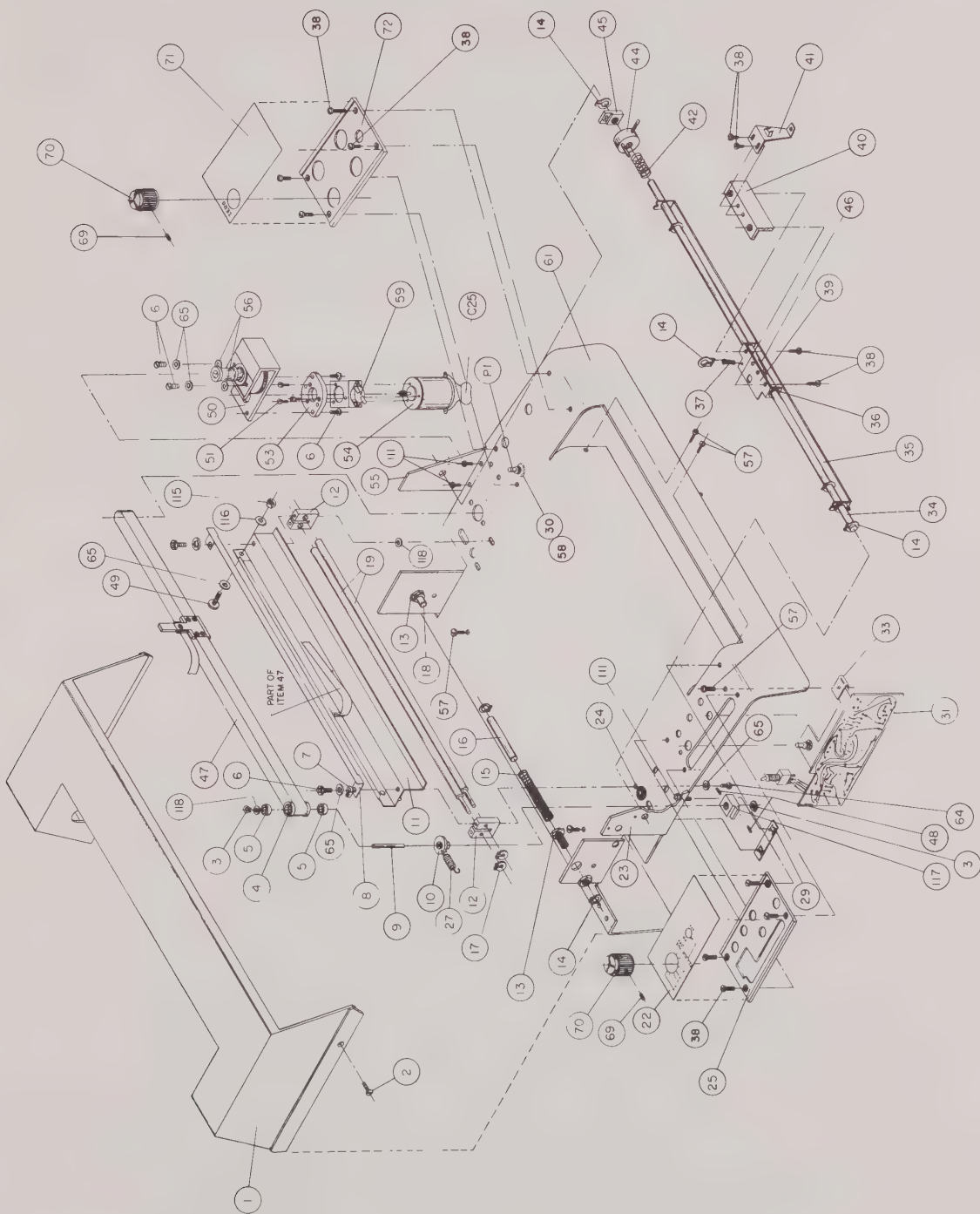


PARTS LIST

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
1	5000-49	Cover	40	5000-7	Insulator Part of 5000-5
2	MH-40	*Flat Head Machine Screw 6-32 x 3/8 (Black)	41	5000-8	Pen Holder Assembly - Y1
3	MH-41	Truarc Grip Ring No. 5555-12-S Part of 5000-353	41	5000-62	Pen Holder Assembly - Y2
4	5000-351	Pulley - Idler Part of 5000-353	42	95-70	Spring
5	MB-112	Bearing Part of 5000-353	44	5000-234	Manual Lift Collar Assembly
6	MH-42	*Phillips Pan Head Screw 4-40 x 1/4	45	5000-96	Limit Block
7	MH-83	Solder Lug No. 4	46	5000-355	Alignment Sleeve Part of 5000-5
8	5000-233	Retainer - Y1 Conductor Assembly	47	5000-359	Drive Belt Assembly
9	5000-347	Shaft - Idler Pulley	48	MH-80	Setscrew 4-40 x 1/4 Lg. Part of 5000-353
10	5000-348	Retainer - Idler Pulley Housing	49	MH-101	4-40 x 5/16 BHMS
11	5000-159	Conductor Retainer - Assembly	50	5000-346	Y Axis Gear Train Assembly
12	5000-26	Mount - Capacitor Rod (1 Set)	51	MH-49	*Phillips Pan Head Screw 2-56 x 1/4
13	MB-116	Bushing	53	2000-20	Mount - Motor
14	MH-65	Truarc Grip Ring No. 5555-25-S	54	5000-310	Motor Assembly
15	5000-34	Spring	55	5000-3-2	Bar Mounting Bracket - Right
16	5000-32-1	Pin - Paper Mount	56	5000-235	Spacer
17	MH-89	Truarc Grip Ring No. 5555-17-C	57	MH-50	*Phillips Pan Head Screw 6-32 x 5/16
18	5000-32-2	Pin - Paper Mount	58	MH-86	*Lockwasher No. 7334
19	5000-27	Capacitor Rod	59	5000-197	Thermostat Switch and Mount Assembly
22	**	Nameplate - X Axis	61	5000-2	Platen
23	5000-3-1	Bar Mounting Bracket - Left	64	MH-51	*Phillips Pan Head Screw 4-40 x 5/16
24	MG-153	Grommet - General Cement No. 1041-C	65	MH-52	*Internal Tooth Lock Washer No. 4
25	5000-42	Switch Housing - X Axis	69	MH-54	*Hexagon Socket Set Screw 6-32 x 1/8
27	5000-349	Spring Part of 5000-353	70	MK-3	Knob
29	MH-45	Clip - Tinnerman C-8179-6-1	71	**	Nameplate - Y Axis
30	MH-85	Pot nut Smith No. 1199	72	5000-43	Switch Housing - Y Axis
31	**	Stepper Board - Assembly	111	MH-77	Phillips Pan Hd Self Tap Screw 6 x 3/8
33	MH-47	Tinnerman C-8020-632-3B	113	5000-377	Cover Bracket
34	5000-4	Bar - Pen Carriage	114	MH-63	Phillips pan Hd Screw 4-40 x 1/2
35	5000-95	Lift Bar - Y1	115	MH-46	Nut 4-40 (ESNA No. 22 NTM-40)
35	5000-99	Lift Bar - Y2	116	MH-91	Washer Flat No 4 Lg. Pattern
36	5000-350	Bushing Part of 5000-5	117	5000-352	Housing Plastic Idler Pulley
37	5000-356	Spring Pen Pressure Part of 5000-5	118	MH-109	Shim Washer .010 THK 1/8 I.D. x 9/32 O.D.
38	MH-48	Pan Hd Self Tapping Screw No. 4 Type B x 1/4	C25	MC-261	Capacitor .1 MF 100V Sprague
39	5000-6	Pen Carriage - Y1 Part of 5000-5	P1	MP-410	Potentiometer - Zero
39	5000-60	Pen Carriage - Y2 Part of 5000-59			

* Standard hardware item - quicker and cheaper to buy locally.

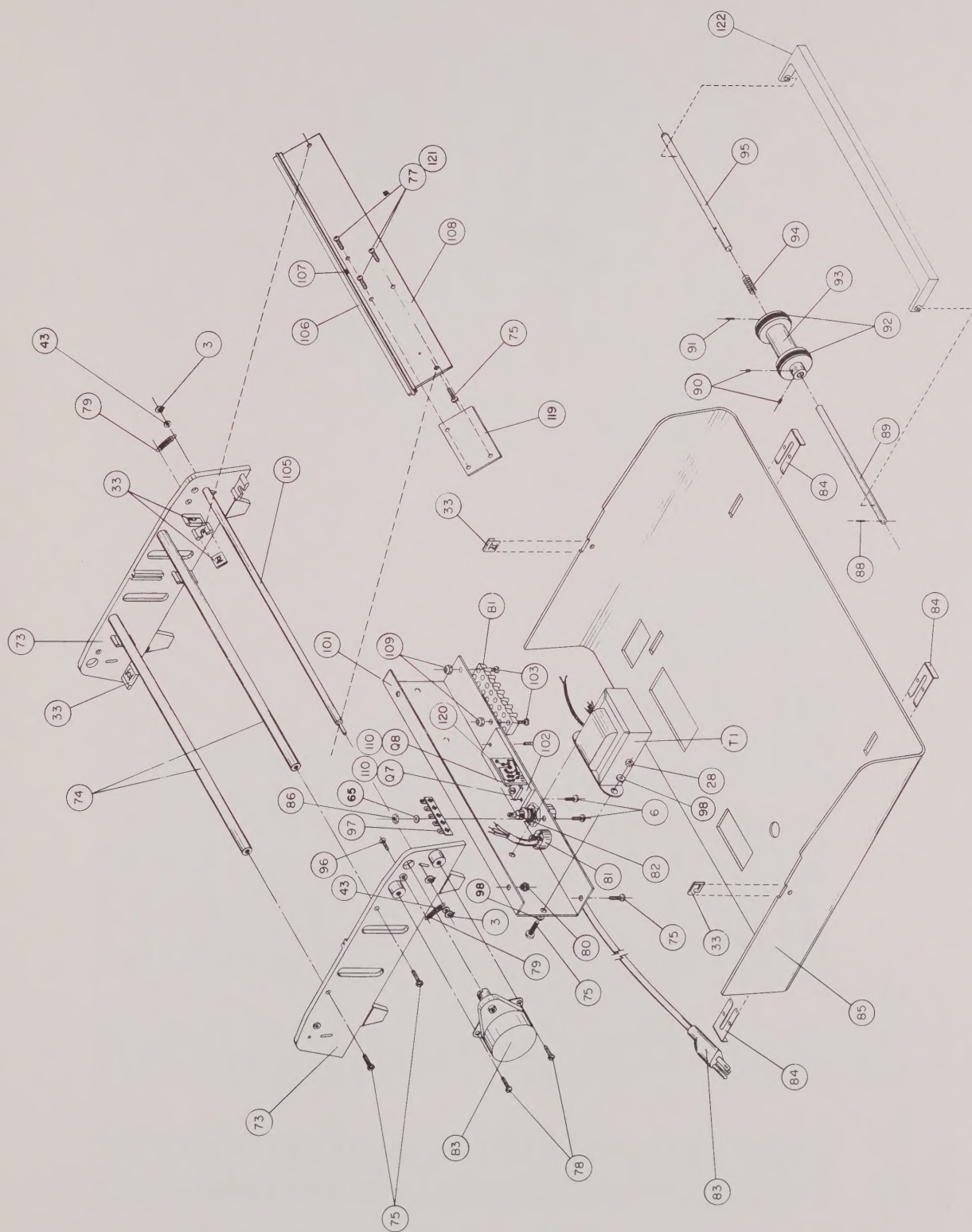
** Depends on model number.



PARTS LIST

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
3	MH-41	Truarc Grip Ring No. 5555-12-C	92	5000-477	Rotary Web Part of 5000-36
6	MH-42	*Phillips Pan Head Screw 4-40 x 1/4	93	5000-37	Drum - Rotary Web Part of 5000-36
28	MH-44	*Nut - 6-32 (ESNA F22NTM-62)	94	3000-167	Spring Part of 5000-36
33	MH-47	Tinnerman No. C-8020-632-38	95	5000-39	Shaft - Spring Loaded Part of 5000-36
43	MH-72	*Flat Washer No 4-40	96	MH-62	Flat Head Self Tapping Screw No. 4 Type B x 1/2
65	MH-52	*Lockwasher - Internal Tooth No. 4	97	MH-67	*Terminal Strip Cinch Jones No. 54-C
73	5000-44	Side Plate Mod Left	98	MH-78	*Flat Washer No. 10 AN960-10
74	5000-45	Separator Bar	101	5000-46	Power Supply Chassis
75	MH-55	*Phillips Pan Head Screw 6-32 x 1/2	102	5000-48	Heat Sink
77	5000-395	"D" Washer	103	MH-63	*Phillips Pan Head Screw 4-40 x 1/2
78	MH-56	*Pan Head Self Tapping Screw No. 4 Type B x 1/2	105	5000-40	Shaft - Paper Loading
79	6550-90	Spring	106	5000-72	Board Mount
80	MH-57	Nut - Miniature 6-32 (ESNA F12CFMA2-62)	107	MH-64	Pan Head Self Tapping Screw No. 4 Type B x 3/8
81	MS-369	Strain Relief	108	5000-496	Amplifier Assembly
82	MF-13	Fuse Holder	109	MH-46	ESNA Nut No F22NTM-40
83	MC-710	Power Cord	110	MH-92	Insulating Plastic Washer - Thermalloy 43-02-14
84	5000-51	Clip	111	5000-478	Tear Bar
85	5000-50	Case	119	5000-493-1	Preamp Board 1MV Assy
86	MH-63	Nut Hex 4-40	119	5000-493-2	Preamp Board 10MV Assy
88	MH-59	*Rollpin 1/16 Dia x 3/8 Long Part of 5000-36	B1	MB-117	Barrier Strip
89	5000-38	Shaft - Drive Part of 5000-36	B3	5000-344	Stepper Motor Assembly
90	MH-60	*Hexagon Socket Set Screw 4-40 x 1/8 Part of 5000-36	Q7	MQ-74	Transistor - MJE 700
91	MH-61	*Rollpin 1/16 Dia x 1/2 Long Part of 5000-36	Q8	MQ-75	Transistor - MJE 800
			T1	MT-136	Transformer

* Standard hardware item - quicker and cheaper to buy locally.



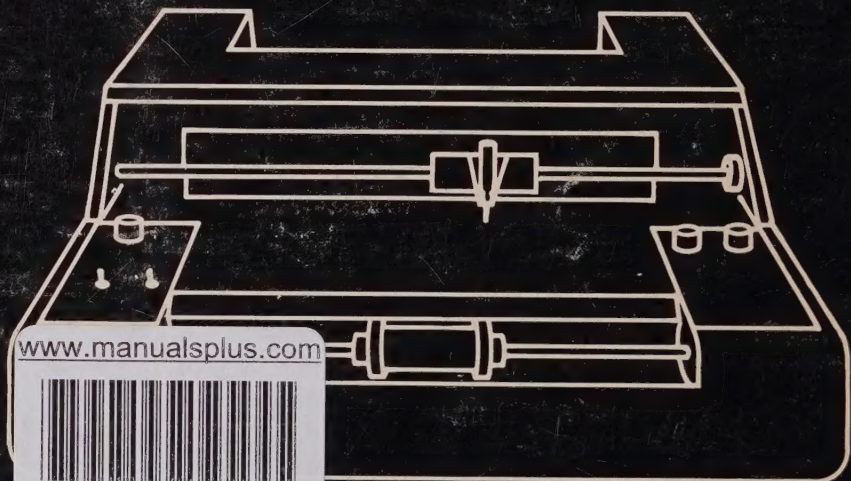
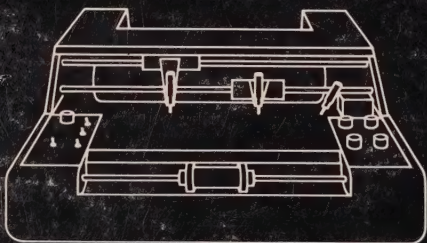
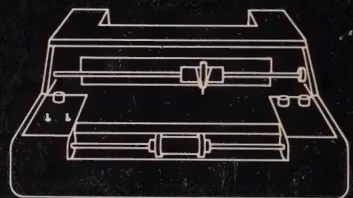
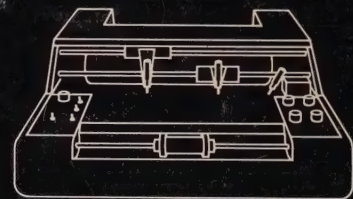
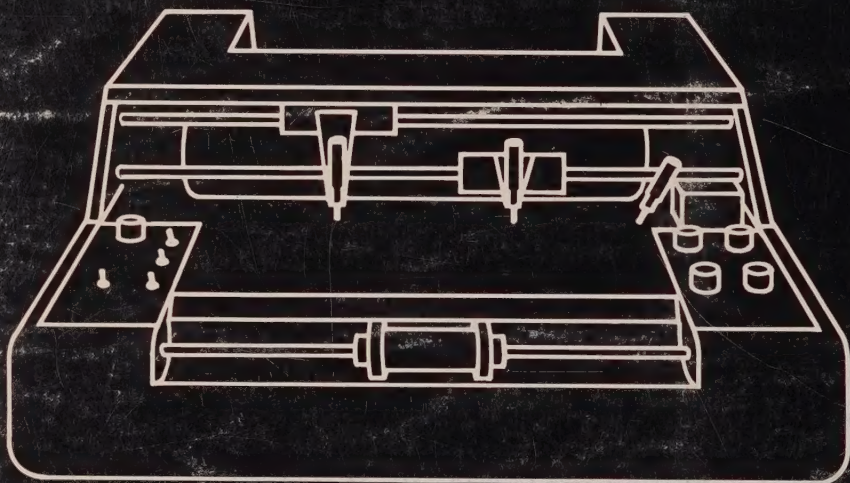
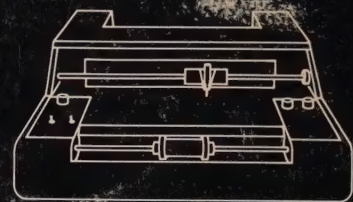
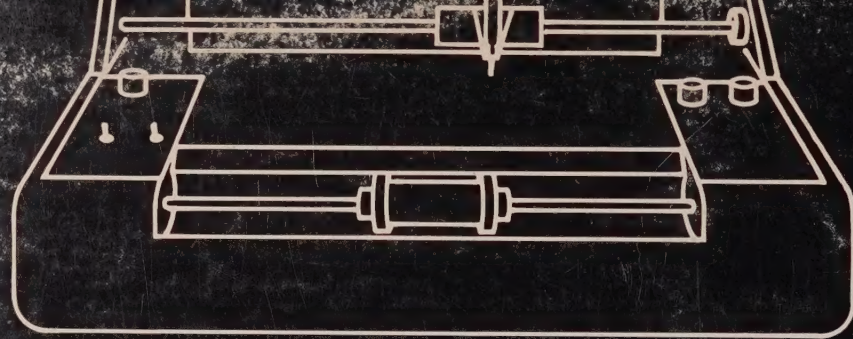
PARTS LIST

Ref. No.	Part No.	Description
1	5000-493-1	Preamp Board 1MV Assy.
2	5000-492	Preamp Board Drilled
3		Jumper Wiring
4		Jumper Wiring
5	MC-1144	Connector - Female-6 Ckt-Molex 09-52-3062
C1	MC-377	Capacitor - .022MF-Metal Mylar-±10%-Plessey 160.22K100D
C2	MC-377	Capacitor - .022MF-Metal Mylar-±10%-Plessey 160.22K100D
C3	MC-452	*Capacitor - 2PF-Dipped Mica-±0.5PF
C4	MC-375	Capacitor - .01MF-Metal Mylar-±10%-Plessey 160.01K630C
C5	MC-376	Capacitor - 0.047MF-Metal Mylar-±10%-Plessey 160.047K250C
C6	MC-395	**Capacitor - 30PF-Ceramic-±1KY
C8	MC-377	Capacitor - .022MF-Metal Mylar-±10%-Plessey 160.22K100D
C9	MC-395	Capacitor - 30PF-Ceramic-±20%-1KY
C10	MC-377	Capacitor - .022MF-Metal Mylar-±10%-Plessey 160.22K100D
IC1	MW-224	Integrated Circuit - Chopper Selected CD4007AE
IC2	MW-372	*Integrated Circuit - LF355N-National
IC2	MW-210	**Integrated Circuit - LM308N-National
IC3	MW-206	Integrated Circuit - CD4007AE-RCA
IC4	MW-210	Integrated Circuit - LM308N-National
R1	MR-1229	Resistor - 91K-1/3W-5%-Carbon Film
R1	MR-963	***Resistor - 1K-1/3W-5%-Carbon Film
R2	MR-310	Resistor - 100K-1/3W-5%-Carbon Film
R3	MR-481	*Resistor - 33K-1/3W-5%-Carbon Film
R4	MR-474	*Resistor - 6.8K-1/3W-5%-Carbon Film
R5	MP-454	*Potentiometer - 25K-Carbon-CTS201-25K
R6	MR-964	Resistor - 47K-1/3W-5%-Carbon Film
R7	MR-964	Resistor - 47K-1/3W-5%-Carbon Film
R8	MR-980	Resistor - 2.2Meg-1/3W-5%-Carbon Film
R9	MR-980	Resistor - 2.2Meg-1/3W-5%-Carbon Film
R10	MR-964	Resistor - 47K-1/3W-5%-Carbon Film
R11	MR-979	*Resistor - 4.7K-1/3W-5%-Carbon Film
R11	MR-178	**Resistor - 22K-1/3W-5%-Carbon Film
R12	MR-310	*Resistor - 100K-1/3W-5%-Carbon Film
R12	MR-964	**Resistor - 47K-1/3W-5%-Carbon Film
R13	MR-310	*Resistor - 100K-1/3W-5%-Carbon Film
R13	MR-964	**Resistor - 47K-1/3W-5%-Carbon Film
R14	MR-1294	Resistor - 61.9K-1/2W-1%-Dep. Carbon, No Subs.
R15	MR-1291	*Resistor - 249 Ohm-1/2W-1%-Dep. Carbon No Subs.
R15	MR-1300	*Resistor - 2.55K-1/2W-1%-Dep. Carbon No Subs.

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* FOR -1 ONLY
** FOR -2 ONLY
*** WITH ATTENUATOR OPTION

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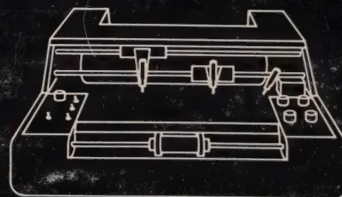
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SE Labor Notes
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